LIMITED
WRD/MKG/INF/L.100
27 May 1963
ORIGINAL : FRENCH

ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST,

CAMBODIA, LAOS, THAILAND AND VIET-NAM.

Committee for Coordination of Investigations
of the Lower Mekong Basin

YEARLY REPORT ON THE ACTIVITIES OF THE FRENCH ICHTHYOLOGICAL MISSION

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The Ichthyological Mission's main objective for 1962, was the study of the consequences, upon the fresh water fish of Cambodia, of the construction of a dam on the Tonlé Sap.

Investigations, accordingly, chiefly centered around the following factors:

- Fish migrations,
- Locating the spawning sites,
- Oecology,
- Nature of the water (physico-chemical analysis),
- Geographic distribution of the different fish varieties,

etc,

In January 1962, a general survey of the Great Lake was undertaken with Mr.d'AUBENTON and Mr.CARBONNEL (sedimentologist), with the chief purpose of exploring the lakes (the great and the small one), inspecting the approaches to these lakes and of the stungs which flow into them, as well as visiting all the directors of the Service des Pêches of the various areas.

DOWNSTREAM FISHING

The way in which fish move from one place to another in Cambodia being related to the flood and ebb periods, that is with the current, one of the most important fishing campaigns takes place during the ebbing period from November to February.

During this period, we rented and operated a day located on the Tonlé Sap.

/This experimental..

This experimental fishing was constantly controlled, day and night, during the months of November and December 1961, and January and February 1962.

All the fish caught on the day during those four months was weighed, sorted, weighed again for each individual species, counted, measured (for some kinds only) and sometimes dissected.

"Weight-length" curves were prepared for the varieties considered as specially valuable.

The gonads and livers of numerous species were cut out, weighed, marked and preserved.

All the data collected during those four months of experimental downstream fishing were tabulated, and are now being processed by Mr. d'AUBENTON at the Paris Muséum National d'Histoire Naturelle.

We also, during the same period, collected for future laboratory study in Paris all the species of fish that we could catch. They were labelled, carefully packed, preserved in formol and are now in Paris where Mr. d'AUBENTON is studying them.

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GREAT LAKE

Beginning in February-March, the water of the Great Lake having sufficiently withdrawn, fishing begins in that huge natural Cambodian reserve.

The Direction du Service des pêches of Cambodia having put a river house at our disposal at Snoc-Trou, we installed in it a little "base". From Snoc-Trou, located exactly at the entrance of the small lake, we could travel around and prospect all the fishing sites located on the little lake and the southern half of the Great Lake, (the other half of the Great Lake being investigated from Siem Reap).

/The investigations..

The investigations on the fishing and fishes of the lakes mainly centered, as in the case of the Tonle Sap, around the following:

- the different varieties caught;
- the tonnage caught;
- the movements of these fishes (checked upon by means of additional fishing at Snoc-Trou bar);
- their diet;
- the maturity point of the gonads (ascertained through numerous dissections, on the spot and at the Snoc-Trou base);
- the "weight-length" factor of many species (ascertained through individual weighing and measurement);
- the kinds of fishing systems used, with indication of the kinds and quantity of fish caught with each type of apparatus, etc.

The small lake and part of the Great Lake were thus methodically prospected.

One or several specimens of the different kinds of fish caught in the lake were also preserved and sent to Paris, as well as a number of gonads.

At the end of March 1962, the Stung Sen was chosen for a special survey, as on this stung, very richly populated, a number of dams have been installed to catch the fish coming from tributary preks and as well as from the ebbing bengs.

On every dam on the Stung Sen, as far as in vicinity of Kompong Thom, the fishing was controlled as above: tonnage, species, weight for each different species, sizes, degree of maturity of the gonads, and so on.

As in the case of the data concerning the fishing on the Tonlo Sap, the information gathered and the results were typewritten, tabulated and sent to Paris where Mr. d'Aubenton is studying them.

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MEKONG

The month of April being low-stage period on the Mekong, two surveys, one in the region of Stung Treng, the other in the region of the Sambor

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falls, were undertaken in April 1962.

During the first two weeks, we prospected and fished in the Mekong and its tributaries (the Srepok, the Se San and the Se Kong) within a radius of about twenty kilometres around Stung Treng.

Sampans were rented on the spot for river travelling and carrying all the equipment required for the survey.

The hiring of guides was also a necessity, both on account of the currents, which sometimes are dangerous in those reaches, and for the locating of fishing sites.

Local fishermen were questioned about the tonnage of fish caught, the species, sizes and so on.

We also did some day and night fishing to check upon the information thus received.

Investigations in that area were conducted along the same lines as before, that is in connexion with tonnage, species, dissection, length-weight ratio, and so on.

Many specimens caught in that area were preserved, taken back to Phnom-Penh, prepared and sent to Paris.

On the way back, between Stung Treng and Phnom-Penh, all the stungs we encountered were studied with special care and thoroughly investigated.

These stays on and surveys of the different stungs enabled us to make good progress in connexion with the study of the geographic distribution of the species.

Many specimens were in this case also weighed, measured, dissected and classified for collecting purposes.

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The two last weeks of April were devoted to the study and prospection of the region of the Sambor Falls on the Mekong.

This is a region of falls and troughs, sometimes very deep, with its own special and little known fish life, and which could not be overlooked. It is very wild and practically uninhabited and very probably was not ever surveyed for ichthyological purposes.

The strong currents, whirlpools, and reefs made the exploration

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especially difficult.

It could not have been undertaken without guides, who were hired locally.

We rented sampans, tied them together and fitted them with a 15 H.P. outboard motor.

Upstream navigation on these rapids, over nearly 40 kilometres, was difficult and sometimes dangerous.

Fishing was conducted by day and by night, both by angling and with nets or cast-nets.

The fish thus caught was weighed, measured, dissected, prepared for collecting purposes, photographed, etc.

These two surveys on the Mekong, in the regions of Stung Treng and Sambor, enabled us to make some headway in the study of fish migrations as well as in the geographical distribution of the species.

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LARGE SCALE FISHING ON THE GREAT LAKE

The month of May is, with the month of April, the period of lowest water-level on the Great Lake. The volume of water being considerably reduced and the fish almost no longer crossing the bar at Snoc-Trou at that time, they find themselves virtually locked up in great numbers in the lake, and fishing is practised on a large scale.

The month of May was accordingly, like those of February and March, devoted to the control and study of the fish remaining in the lake during that period.

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EXPERIMENTAL FISHING DURING FLOOD PERIODS
(Upstream Movement of Fish)

The Ichthyological Mission wishing to control the upstream

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movement of fish, that is the fish entering the lake with the flood waters, we set up in the main preks of the Snoc-Trou bar several experimental fishing stations during the months of June and July.

We secured from the Direction des Pêches du Royaume permission to fish during the closing period.

Several dams, days and yors have so been installed on the busiest preks right from the beginning of the upstream migration.

This experimental fishing was controlled and studied uninterruptedly, round the clock, during all the month of June and the first part of July. The fish caught was weighed, sorted by varieties, weighed again for each individual species, counted, measured in the case of some species, and occasionnally dissected. The point of maturation of the gonads was ascertained and noted down for interesting varieties, etc.

During the same period, plancton fishing was carried out by day and by night. This plancton is now in the Museum National d'Histoire Naturelle in Paris where Mr. d'Aubenton is studying it. The results of his studies on the plancton will enable us to gather more precise information on the nature of eggs, fingerlings, and others entering the lake with the flood waters.

All the information gathered through this experimental high-stage fishing has been noted, tabulated and is at present being studied in Paris by Mr. d'Aubenton.

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We also carried out in August, in cooperation with the Hydrological Mission and the Sedimentarion Mission, a sampling and physico-chemical analysis survey of the work, in the region of Battambang, with particular attention to the Stung Sang Ké and its tributaries. Many samplings, both from the bottom and from the surface, were taken. The results of the analysis, made by the Institut Pasteur, are now processed in Paris by Mr. d'Aubenton.

Also during the month of August, we controlled the fish movement at kilometer 54 on the road Phnom-Penh - Kompong Cham. At a certain stage of the flood period, when the river reaches a certain level, part of the water

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of the Mekong flows along a canal, probably natural, which crosses the road at kilometer 54. That water washes the bengs as it flows along in the direction of the Tonle Sap. A very important fish movement takes place at that time.

We checked upon the travelling varieties and weighed, measured and preserved some interesting specimens for examination purposes in Paris.

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Mr. SCHMID's Botannical Mission being announced, we also made in August a survey of the region of Kompong Cham, on waters with certain desired peculiarities (trees that have been immersed for some time, etc.)

Mr. d'Aubenton's mission on the ichthyological study of the lower Mekong Basin and on the Tonle Sap coming to an end at the end of September, that month was used for working on certain documents, classification, sending fishes to Paris, as well as for many interviews with the Direction des pêches etc.

Mr. d'Aubenton left Phnom-Penh on 27 September 1962.

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During the month of October I did some surveying and small-scale fishing on the sturgs flowing into the Great Lake and in the Snoc-Trou region, for the purpose of stuying the fishing apparatus utilized, the varieties of fish caught, their sizes, weights, state of maturation of gonads, etc.

During the same period, a reconnaissance was made with a view to preparing the Botannical Mission on all the perimeter of the great and the small lake, with particular reference to the Tonle Chhma area.

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DOWNSTREAM FISHING

Ebbing-water fishing, when the fish is travelling downstream, is practised during the months of November, December, January and February. During the first half of November I studied fishing in the Tonlé Sap, controlling, as during the previous year, tonnage, weight by species, numbers, etc., as well as the fishing systems used, their yield for each species, both from the quantitative and qualitative viewpoint. The latter type of research was carried

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out within the frame of the study on "Fishing Technology".

These activities were carried out on all the days between Phnom-Penh (Quatre Bras) and Kompong Chhnang.

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In November also, I went with Messrs. BERTHELOT and LORGERE on a survey, covering over 350 Km on the Tonlé Toch.

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Mr. SCHMID's Botanical Mission also took place during the second half of November. The northern part of the great lake was first prospected from a base located in Siem Réap.

All the flooded forest north-est of Siem Réap was surveyed. All the stungs, preks and bengs of the region were prospected in the same way. All the flooded forest area of the western coast of the great lake, from Stung Sang Ké to Stung Prusat was prospected, all the stungs, preks and bengs were studied. Towards the end of the mission, from Siem Réap, we prospected the eastern coast from Siem Réap to Tonlé Chhma, the flooded forest and the stungs, preks and bengs.

From our base at Snoc-Trou, we then prospected the small lake and the Snoc-Trou region.

The first days were devoted to the western coast of the small lake where we prospected the flooded forest, the stungs, preks and bengs.

The Tonlé Chhma zone was studied more in detail. This region, very indented and most interesting from the ichthyological viewpoint was prospected in totality. We went up all the stungs flowing into the small lake called Tonlé Chhma and studied them.

The Snoc-Trou bar, the Stung Sen and all the delta between Kompong Chhnang and Snoc-Trou were also prospected.

In the course of that botanical mission, all the stungs and preks were prospected as far up as we could get in a boat, that is roughly up to the extreme limit of the flooded forest.

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All the grass-grown areas on the edge of the lake and the outlet of the stung were explored.

In the course of this mission, Mr. SCHMID took many samples of various plants.

We also took during that survey over hundred pH of the water in the spots considered most interesting.

I lastly took advantage of that general survey of the lake and of the flooded forest to get from all the fishermen I met ichthyological data which will most usefully add up to the information already gathered in the course of the previous year.

During this botanical mission, over 1.000 Km were covered in motor boat on the lakes and stungs.

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DOWNSTREAM FISHING (followed)

All the month of December was devoted to downstream fishing. All investigations, controls and surveys being similar to those done in connexion with November fishing on the Tonlé Sap.

Every day was separately studied; fishing being controlled, then analysed, in relation to the spot, the nature of the current, of the bottom, of the weather, as well as the time. All the information gathered was noted down and sent to Paris where it is processed by Mr. d'Aubenton.

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In addition to those field surveys, the Ichthyological Mission also carried out, or caused to be carried out, various analyses, including:

On the one hand, for 1962, daily physico-chemical analyses of the waters of the Mekong and the Tonlé Sap. These analyses are being made by the Institut Pasteur in Phnom-Penh, and concern the following:

- temperature,

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- pH,
- resistivity,
- dissolved exygen,
- alkalinity,
- hardness,
- turbidity

Furthermore, during the period of flood and the period of ebb, water was sampled and analysed in different stations which we set up in Snoc-Trou.

The results of these analyses was to enable us to observe water modifications in connexion with the progress of forest flooding study thereafter the behaviour of the fish in these different areas.

All the data have been tabulated and sent to Paris where they are being processed.

Tabulations of the floods of the Mekong and of the Tonlé Sap have been set up since January 1, 1961, and are regularly sent to Paris. The water heights are given by the Cambodian services and then tabulated by ourselves.

Lastly, the Ichthyological Mission keeps some fish in ponds for observation purposes. Periodically, some specimens are caught and dissected to check upon the physiological process of maturation in closed space.

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In the course of the downstream fishing operations from November 1962 to January 1963, 66 tons and 433 kilogrammes of fish were caught and examined between 16/11/61 and 17/1/62 on our experimental fishing day on the Tonlé Sap.

During the experimental upstream fishing period, in Snoc-Trou, 26 tons and 948 kilogrammes of fish were caught. They were all studied, weighed, numbered, etc.

In 1961 and 1962 we preserved, then sent to Paris 1, 039 fish from roughly 144 different varieties.

We also caught, preserved and sent to Paris 40 other varieties

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of "small fish".

In the same period, we extracted the gonads from two and a half tons of fish, chosen among thirty-five of the most interesting kinds; they were weighed, preserved and sent to Paris.

The year 1962 was therefore chiefly devoted to the survey of fish migration. These studies were directed by Mr. d'Aubenton until the end of September 1962.

The Ichthyological Mission of the Lower Basin of the Mekong and of the Tonlé Sap has been run by me until the end of 1962.

It will continue until November 1963, when it will more particularly deal with the "technology of fishing". In March 1963, Mr. d'Aubenton will take over the supervising activities.

I cannot,in this report, submit technical conclusions on our mission. Mr. d'Aubenton, head of the Ichthyological Mission, is still working in his laboratory in Paris on the further analysis and research required for a full report and he alone has the authority to submit it.

Phnom-Penh, 4 January 1963

(Signed):FILY

LIMITED

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27 May 1963

ORIGINAL : FRENCH

ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST.

CAMBODIA, LAOS, THAILAND AND VIET-NAM

Committee for Coordination of Investigations
of the Lower Mekong Basin.

END OF THE PROGRAMME OF THE FRENCH ICHTHYOLOGICAL MISSION AND STUDY ON POSSIBLE MODIFICATIONS OF FISHING TECHNOLOGY ON THE GREAT LAKE AND THE TONLE SAP IN CONNEXION WITH THE PROJECT OF A DAM ON THE TONLE SAP.

Working Programme

END OF THE PROGRAMME OF THE FRENCH ICHTHYOLOGICAL MISSION AND STUDY ON POSSIBLE MODIFICATIONS OF FISHING TECHNOLOGY ON THE GREAT LAKE AND THE TONLE SAP IN CONNEXION WITH THE PROJECT OF A DAM ON THE TONLE SAP

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Working Programme

OCTOBER:

In cooperation with the Service des pêchos, preparation of a survey on the fishing methods (a copy of the lists of question submitted to the Service des pêches is given in Annex).

Diagram: fishing sites on the Tonlé Sap and the Great Lake.

Information pertaining to the dates at which fishing is practised at the different fishing sites.

NOVEMBER TO JANUARY :

During the months from November to January, fishing activity is mainly centered around the Tonlé Sap with the days and dams of the different arms. We shall intentionally leave out fishing on the prcks below. Prek Dam, as it is not concerned with the effects of the dam. As far as we know the only spot where fishing begins in December is site No. 4, Kompong Thom on the Great Lake. It is a special case, interesting in this sense that fishing is done at a height of seven metres in the flooded forests, whereas on the other sites, fishing only begins at a height of three metres. It will accordingly be given special consideration.

I. - CONTROL OF FISHING ON THE TONLE SAP :

a/ - Geographical location of fishing systems.

b/ - Days: On each line, a transverse profile and stream velocity, with distribution and percentage of fish varieties for each day.

Stream velocities will be measured in collaboration with Mr. GUISCAFRE. These measurements will have to be made at peak and lowest fish travelling periods, so as to complement the information already gathered on ebb-period migrations in relation to lunar phases.

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c/ - Dams: The fishing dams located on the arms of the Tonlé Sap will also have to be controlled, as well as those on the important preks tributary of the Tonlé Sap.

II. - BOTANICAL SURVEY :

Mr. SCHMID's programme calls for constituting a team with Mr. Fily in order to help that mission in the execution of its work, by giving it advice and guidance in regions of particular interest such as the delta of Stung Battambang, Tonlé Schmar at Peam Beng and the artificial dam of Phnom Preas.

III. - SPECIAL OBSERVATIONS :

a/ - Samplings of water for physico-chemical analysis purposes will be continued, as well as the study of the oecological distribution of fish-life during the ebbing period, that is until water has withdrawn from the flooded forest area.

b/ - Observations on the Trey Pruol fish kept in ponds since December 1961 for the purposes of ichthyological control of maturation in closed water will be periodically continued.

The data to be gathered from the above operations are essential for completing the basic information already available. On the other hand this final stage of the programme will give three more months for stuying the cycle of fishing technology.

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The first survey of the implications of the construction of the dam on the fish being completed, it is necessary to find out what effects the construction of the dam will have on fishing itself. For it does not help to have a good productionif that production cannot be used. The modification of the water surface during the low-water season will necessarily modify the fishing methods on the Great Lake, as well as run-of-river fishing systems.

The survey aims at gaining knowledge of the present fishing conditions and determining the modifications that will result from the building of the dam as well as to submit any appropriate suggestions to the Service des pêches as regards the future operation of fishing on the Great Lake (modification of the fishing system, reserves and regulations).

/This study...

This study being closely connected with economic questions we also could submit useful data to the financial services of Cambodia.

JANUARY - REBRUARY :

a) - Continuation of observations on the Tonlé Sap: days, dams, etc.

A permanent contact with the Service des Pêches for the investigation on the operation and numbering of fishing systems; interviewing fishermen with a view to ascertaining the varieties of fish caught.

BEGINNING OF OBSERVATIONS
ON THE GREAT LAKE

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FROM MARCH TO JUNE ON THE GREAT LAKE:

The survey will continue on the Great Lake and will chiefly bear on the fishing sites on the edge of the floodad forest and large scale drag-net fishing.

The Botanical Mission will, as scheduled, have to continue its study of the flood phenomenon.

Samples of plancton will be taken on the Tonlé Sap from Quatre Bras to the Lake; they will complement those already taken at the Snoc-Trou bar.

FROM JULY TO SEPTEMBER :

Fishing being closed, investigations will be restricted to household fishing, the only kind permitted during that period.

FROM OCTOBER TO NOVEMBER :

The processing of the data thus gathered will be as follows:

a/ - description of the systems used, including a sketch;

/ - method of operation with the dates between which they are used and their specialization;

c/ - the yield for each individual fishing system;

d/ - percentage of industrial and artisanal systems;

/e/...

e/ - approximate total yield of the fishing on the Great Lake and the Tonlé Sap according to the fishing seasons;

f/ - fluctuation of fish prices in relation with the importance of catches and the place where the fish was caught.

For this part of our investigation, we shall require the help of the Service des pêches.

g/ - Rough evaluation of the fish sold as:

1.- Fresh fish;
2.- Smoked fish;
3.- Salt and smoked fish;
4.- Fish paste;

with the list of fish varieties chiefly used for each category.

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CONCLUSIONS AS REGARDS THE BUILDING OF A DAM

a/ - Fishing systems that will have to disappear.

b/ - Fishing systems that will have to be modified especially on the fishing sites located on the edge of the Lake.

c/ - Suggestion for the creation of fish reserves on the edges of the lake.

d/ - Discussion, in cooperation with the Service des Pêches on possible modifications of the regulations concerning fishing methods and the dates of the opening and close of the fishing season.

e/ - Examination, in collaboration with the Service des Pêches, of the possibilities as regards the creation of fishing ports with processing installations (salt fish, dried fish, smoked fish) as well as storage facilities for export purposes, and carrying of live fish by waterways transportation.

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The execution of the above programme will be carried out by Mr. FILY in the absence of Mr. d'Aubenton from October to March 1963.

/In October...

In October, Mr. FILY will in addition to the normal working programme have to conduct soundings on the Great Lake for the benefit of the Sedimentation Mission.

We fully concur with the suggestion of the Director of the Service des Pêches to second an inspector of the fisheries to the Technological Mission for training purposes. He might be given a fellowship upon the completion of the mission to enable him to receive further training in that field.

LIST OF QUESTIONS

Investigation on Fishing Systems

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I.- INDUSTRIAL FISHING :

Description of the fishing site:

a) - location

b) - fishing systems, with their dimensions

c) - date of the opening of the season

d) - working over a certain period (how it is affected by the lowering of the water level.

e) - main fish varieties, with dates

f) - tonnage for each variety

II.- ARTISANAL OR HOUSEHOLD FISHING :

a) - location

b) - fishing systems

c) - numbers

d) - importance of yield, with dates

e) - main varieties caught

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ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST.

CAMBODIA, LAOS, THAILAND AND VIET-NAM

Committee for Co-ordination of Investigations
of the Lower Mekong Basin.

PROGRESS REPORT 1962

French Sedimentation Mission

J. GUISCAFRE
hydrologist

J.P.CARBONNEL
sedimentologist

FRENCH SEDIMENTATION MISSION

PROGRESS REPORT

for 1962

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The French Sedimentation Mission has been installed since 15 January 1962, when the Mission Sedimentologist arrived. The Hydrologist arrived at the end of February.

1.- WORKING CONDITIONS.-

A.- SEDIMENTATION LABORATORY.-

a)- PREMISES

As a purely unofficial measure, the Service des Pêches of Cambodia made available to the French Sedimentation Mission premises it had in the building of the Ecole Royale d'Administration at Chak-Angré. These premises, which were partly equipped as a laboratory (laboratory benches, hood) have been reconditioned, as well as the equipment made available to the Mission.

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b)- EQUIPMENT

The equipment used by the Sedimentation Mission for the year under review comes from two sources:

- equipment loaned by the Institut Piscicole (drying-closet, scales, sampling bottles).
- equipment purchased by the Mission from French Assistance funds.

The latter includes some simple laboratory equipment (sieves, cupels) and field equipment (boats, motors, drills, earthgrab, Ph.meter, thermo-sounding devices).

Further laboratory equipment (a machine of the Rotap type) has been received.

c)- PERSONNEL

In addition to the Mission Sedimentologist, the sedimentation laboratory personnel now includes one technical assistant and three Cambodian trainees, assigned by the Government services to which they belong to the French Mission. They receive a technical assistance training at the laboratory and a field training (navigation, samplings), as well as a preparation to office activities (computation, drawing).

d)- ACTIVITIES

The Sedimentation Laboratory which has been operating since June has so far limited its activity to a summary examination of the samplings and drilling cores taken during the year by the Sedimentation Mission. The

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methods chiefly used to-date are: description, log, underwater sifting, water-contents, particle-size study, sediment transport, calcimetry.

Special studies requiring either specialized equipment or specialized technicians will be made in France (heavy minerals, densimetry, dehydratometry).

The idea has not been to create a highly specialized installation, but to lay the foundation for a laboratory that might subsequently be expanded should the investigations being conducted so require or the Cambodian Government so desire.

B.- COOPERATION WITH THE CAMBODIAN GOVERNMENT SERVICES.-

For the preparation of the hydrologic appraisal required by the sedimentation survey, we are cooperating closely with the Arrondissement de l'Hydraulique et de la Navigation of the Public Works Department.

We thus trained the personnel required for the survey, so far three teams numbering altogether nine workers.

The hydrometric equipment utilized in the course of this year was that of the French Sedimentation Mission.

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II.- MATERIAL COLLECTED DURING THE CURRENT YEAR.-

A.- GEOLOGY.-

The geology of the region under consideration was studied from two different angles:

1°/- Lithology of the Drainage Areas

A number of surveys conducted around the Great Lake as well as on the drainage areas of the tributary stungs of the Great Lake enabled us to study the different geological and pedological aspects of those regions.

Samplings of rocks and soils were taken for mineralogic and particle-size study. In this manner, the drainage areas of the Great Lake have been divided in a number of groups according to whether the rivers which drain them are transporting sand, or not.

2°/- Quaternary history of the Great Lake Basin

Several surveys, one of which was made with Professeur SAURIN, enabled us to make cross-sections in the continental formations of Cambodia. This study which we expect to continue next year is aimed at giving us stratigraphic landmarks in the quaternary history of the region. These landmarks we shall endeavour to relate to our investigations in the matter of lakes.

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B.- HYDROLOGY AND SEDIMENTATION APPRAISAL.-

1.- Meteorology.

The meteorological data concerning the Great Lake Basin are given us by the Service Météorologique du Cambodge.

The evaporometric network had to be completed by two floating stations (pans) and 15 Piche stations.

2.- Gaging Stations.

The gaging network of the Great Lake Basin currently comprises 45 gaging stations, four of which are equipped with recording systems; one of these was installed in the middle of the Lake at 11 Kilometers from Kompong-Luong.

- 85% of the gaging stations have been installed or reinstalled during this year by the Arrondissement de l'Hydraulique et de la Navigation.
- 30% of the stations are currently controlled by the Nivellement Général Khmère; the others will be in the course of the dry season.

3.- Measurement of Liquid Discharge and Rating.

Twenty-three streamgaging stations are distributed around the Great Lake, enabling us to control, in addition to the outflowing and inflowing water-courses, 75% of the Great Lake Basin upstream of R.N.5 and R.N.6.

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In connexion with two of these stations, installed by Harza, a rating was established and is being completed by us: the TONLE-SAP at PREK DAM and the STUNG SEN at KOMPONG-THOM.

For the rating of the other stations, 125 streamgaging measurements, made during the last rainy season, are available.

4.- Sediment Transport.

Approximately two thousand water samplings for the study of sediment transport were made with every streamgaging measurement, and every time the stations for which a rating-curve already existed were visited; a total of 135 measurements of average solid sediment transport in suspension in the sections.

C.- PHYSICO-CHEMICAL STUDY OF THE WATER.-

Three different aspects of the problem were studied during the current year:

1)- Distribution of the water at high stage periods in the vicinity of the "Seuil de Snoc-Trou." This study enabled us to follow the mixing process of the waters of the Tonlé Sap and Stung Sen as they enter the Lake, on the surface as well as below.

2)- Variations of the physico-chemical characteristics of the water of the Great Lake during first 36 hours' uninterrupted observation at high stage period.

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3)- Systematic measurement of free iron ions in the tributary stungs of the Great Lake according to the same sampling programme as for the solid discharge in suspension, and measurement of the same free ion in the Lake at regular intervals. This investigation will enable us to summarily appraise the amount of free iron contained as a solution in the Lake Basin. We realized that free iron ions were playing an essential part in the sedimentation of chemical origin of lake clays.

In addition to such specific studies, we also made during our surveys a number of observations in the field of temperature, pH, turbidity, etc. which enabled us to clarify a number of problems.

D.- CORE-DRILLINGS.-

Two types of core-drillings were made:

Small core-drillings made with a collapsible hand-drill. About forty locations have been investigated in this way during the period under review.

All these samplings were studied at the laboratory to an extent commensurate with the equipment and the laboratory personnel described above.

Large core-drillings. For the campaign of large core-drillings, we had to fit out at a ten meter junk boat. It was equipped with a five-meter "bigue"

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(jib installed in front), a hand windlass, a Zullig-type sounding-apparatus, three anchors and an outboard motor. This type of craft has the advantage of having a shallow draught (forty centimeters) which enables it to be used at low-water stage and makes it fairly stable when not in motion. The sampling campaign which began at the end of August produced twenty cores evenly distributed on the surface on the Great Lake.

The laboratory processing for ten of these samples was conducted along the same lines as for the small ones. All were opened, described and the water contents determined. Altogether over 30 meters of large core-drillings were studied.

These drillings enabled us to ascertain the comparative homogeneousness of the cross-sections obtained. The pattern of a stratigraphy of recent quaternary sediments could thus be established. No sedimentation of rythmic type was reveled and so far analysis results gave no indication of such sedimentation pattern.

Along with this drilling campaign, samples of surface sediments were taken whenever deemed necessary. In this field too, as far as lake conditions are concerned, the homogeneousness of surface sediments is, from a macroscopic viewpoint, rather remarkable. Analyses are being conducted; they will reveal whether that homogeneousness still prevails under more minute observation (heavy minerals, iron ...)

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III.- PROSPECTS FOR 1963.-

In 1963, the French Sedimentation Mission expects to continue and expand its programme of hydrology and, in connexion with it, its programme for the study of solid discharge. This programme has been outlined in a previous report.

As far as the study of solid sediment transport goes, the Sedimentation Mission has during the current year given consideration to the problem and thinks of building a sedimentation pit on a sand-transporting stung, according to the results of preliminary experiments.

The sedimentation survey will be continued on the Great Lake according to the data gathered in the course of the current year; investigations will be extended to the Veal Pok area, south of the Seuil of Snoc-Trou. The same applies to geological surveys.

The physico-chemical study of the water will be carried out according to the programme described above; in addition, a study will be made of the waters of the Tonle Sap at high-stage period between Prek Dam and Snoc Trou.

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ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST

CAMBODIA, LAOS, THAILAND AND VIET-NAM

Committee for Coordination of Investigations of the Lower Mekong Basin

Nineteenth Session (Plenary)
8 - 14 January 1963
Vientiane, Laos

STATEMENT OF WMO EXPERT

at

the Nineteenth Session of the Mekong Committee

STATEMENT OF WMO EXPART

at

the Nineteenth Session of the Mekong Committee

Mr. Chairman,
Gentlemen,

..... The Committee will remember that six months ago, in June 1962, we bade farewell to Harza Corporation, whose contract had come to an end.

Situation at time of departure of Harza Corporation

Generally speaking, the situation at the time of departure of Harza Corporation was as follows: in accordance with the recommendations of the Wheeler Report, a network of hydrologic stations, consisting of 31 recording gauging stations and five non-recording stations, had been installed. These recording gauges had been delivered to the Japanese Team working in Laos, and three recording gauges which it had not been possible to install owing to security conditions were still to be set up on the Nam Ou, the Nam Sung and the Se Done. A network of 50 meteorological stations had been set up as recommended in the Wheeler Report; the installation of 29 stations has been delayed for similar reasons of security.

A staff of some 100 operators and engineers had been trained to ensure continuation of the programme. Equipment and current consumption goods valued at some $500,000 (United States, France, New Zealand, United Kingdom) had been transferred to the Committee. This equipment includes transport equipment, technical equipment for the gauging stations, scientific and office equipment. The transfer of title of this equipment was effected according to a memorandum of agreement signed during the Eighteenth Session of the Committee, held in Bangkok, and providing that said equipment would be used to continue the survey work begun by Harza Corporation. To be complete, we should also mention the new offer made by the United states delegation during the Eighteenth Session and gratefully accepted by the Committee, for provision of spare parts and equipment for certain portions of the network during the

/ next five

next five years. According to the estimation of the engineers and the WMO expert, about $220,000 would be necessary during the next five years to ensure maintenance of all the above-mentioned equipment. Finally, apart from the installation of the hydrologic and meteorologic networks, the training of personnel, and the transfer of equipment, the three-year Harza programme also included the preparation and publication of 11 reports on basic data, a complete set of which has been distributed to each of the members of the Committee.

Continuation of programme

During the last year of the Harza programme, the Office of the Executive Agent had been considering in cooperation with Harza Corporation, the question of organization of the four hydrologic services, one in each riparian country, who would ensure continuation of the work after expiration of the Harza contract. These services have in fact been set up within the framework of the Public Works Department in Cambodia, Laos and Viet-Nam, and under the auspices of the National Energy Authority in Thailand. The programme has been continued according to the recommendations of the Harza engineers and of the WMO Expert. Some 200 additional discharge measurements have been made in all hydrologic stations, and the basic data has been systematically collected, classified and partly analyzed. Generally speaking, the equipment had been well maintained, taking into account the fact that it had already been in service for over two years, and considering the incomplete technical training of a certain number of operators.

No programme is wholly without incidents, and some incidents occurred due to circumstances beyond the control of the operators: a 24-foot boat was burned in Viet-Nam due to an accident, the recording gauge at Thakhek has to be re-installed due to a landslide on the river bank, the staff of the recording gauge at Stung Treng as well as the pressure intake was destroyed by the Mekong, the slope of the recording gauge at Kompong Chhnang was upset by a land subsidence, a jeep was damaged in an accident in Thailand and will have to be replaced as soon as possible, etc.

Generally speaking, in spite of those incidents the data collection programme continued without interruption.

Current problems

At the end of this six-month programme, I feel it is necessary to give a general picture of the position in the light of experience gained and to

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evaluate our current problems. Such problems or difficulties include four categories: personnel, equipment, organization and budget.

Personnel. In charge of the four hydrologic sections are graduate engineers who took up their functions in 1962 in a satisfactory manner. These engineers control a certain number of observers. In order to avoid any misunderstanding, let us state that the term "operators" refers to technical assistants with no thorough theoretical training. In part I wish to comment on the qualifications of such "operators".

In all modern organizations there is a personnel pyramid headed by the Engineer-in-charge, who supervises the auxiliary personnel, which becomes more and more numerous as we go down the scale. A good structure of the basis of such a pyramid, represented in this case by the operators, is indispensable in order to ensure maximum efficiency. I stated a moment ago that generally speaking the engineers are perfectly competent for the implementation of their task; they generally have excellent knowledge of English or French and have been able to derive maximum benefit from the training provided by Harza; on the other hand, it is obvious that this category of personnel can more easily obtain foreign scholarships than the operators. In consequence, our main lack is for intermediate implementation personnel, i.e. the operators, and it is indispensable to consider necessary ways and means to train such personnel. I might choose examples in the field of hydrology or meteorology or in any other field, but I shall select, to illustrate our need for operators, an example in the field of mechanics: we have a total of 25 boats and 13 jeeps; in particular, the 24-foot boats used for hydrologic measurements are equipped with 50 H.P. outboard motors. These 50 H.P. motors are not only complex, but also costly. A motor which has been badly maintained by a non qualified operator involves expenses and interruptions in the programme. I have been able to observe during my various field trips that there is no lack of good will, therefore it is only necessary to find a practical method to provide the necessary training, especially in the field of mechanics, where our need is the most urgent. In my view, the training of this operator personnel might be envisaged in three different ways:

/ - Training

- Training periods, possibly organized under external scholarships;
- Local technical schools;
- Training under the supervision of experts.

I reserve the right to discuss this later with the parties concerned, but I wish to draw the attention of the Committee to this problem immediately.

Equipment. This problem has been partly solved thanks to the project for provision of spare parts and equipment, for which the memorandum of agreement is ready for signature. Nevertheless, I should like to insist upon three points, viz:

- The question of time: in a certain number of cases in Viet-Nam, where a boat was destroyed; in Thailand, where a jeep was badly damaged in an accident and has to be replaced; in the case of certain recording gages; for instance, we have an urgent need for spare parts and equipment; any delay implies an interruption in the implementation of the programme.

- It is also necessary to provide for sufficient flexibility for the replacement of the necessary equipment; for instance, constructors no longer produce 50 H.P. motors; therefore, it will be necessary to consider two 40 H.P. motors, or one 75 H.P. motor, or another acceptable solution. The Viet-Nam boat (24 feet) has to be replaced; the Viet-Nam Navigation Department might build such a boat, provided a certain quantity of imported raw materials is furnished.

- There is also the question of storing, which is related both to the problem of training of operators and to the problem of organization.

Organisation. At the center of operations, the problem has been solved with the recruitment of two assistant hydrometeorologists in Vientiane and Phnom Penh, and of a General Service agent, a secretary and a draughtsman in Bangkok. On the local plane, the organization effort should be continued under the supervision of the Engineer-in-charge.

Budget. In 1962 a total budget of $323,000 was contemplated for all four countries for the 1963-1964 financial year. It is now necessary to make provision for the 1963-1964 budget, for which estimations will be facilitated by our recent six months of experience.

Programme

In my view, the three-year Harza programme must be considered as a beginning in the inventory of the water resources of the Mekong Basin.

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This being so, the Harza network of stations constitutes the backbone of the complete network to be established in the years to come. Therefore, I feel it will be necessary to expand this network and to consider a realistic optimum programme, taking into account current resources in equipment and personnel. The operation of such a network and the collection of basic data on additional tributaries will make it possible to provide answers in fifteen, twenty or thirty years' time to the questions which were already raised five years ago and led to General Wheeler's recommendations. At the beginning, it might suffice to install a few additional staff gages, which are not costly, and to appoint an observer; a programme of discharge measurements might be carried out with the existing equipment and teams, including the cooperation of the assistant hydrologists headquartered in Vientiane and Phnom Penh. Expansion of the hydrologic network is also necessary to solve the related problems of local construction of bridges, roads, dikes, levees, etc., all these problems having already been raised with the framework of Mekong projects, such as the projects for a delta model or for flood warning. The Mekong delta presenting some of the most complex hydraulic problems in the world. Every cubic meter of water artificially used involves perturbations extending throughout the system. In other terms, for instance any hydraulic structure downstream of Kratie must necessarily be based on ample hydrologic data which we would be well-advised to collect as from now.

For instance, in Viet-Nam, the area from Chau-Doc on the Bassac appears to function in flood period as a collector for a substantial portion of the Mekong discharge. A priori, a molecule of water moving down from Kratie can reach the sea, by two possible routes, i.e. through the Mekong or through the Bassac. But in fact there is a third possibility: to overflow from the Mekong bed into the drain between the Mekong and the Bassac, and then to follow the Bassac, then Chau-Doc River, and Takeo River and to arrive by that oblique route somewhere in the vicinity of Chau-Doc. Roughly speaking, we may say that any overall development of the delta should include a water collection in that area. Therefore, it should be interesting to know as soon as possible how the waters are distributed in the region. In other terms, the average discharge of some

/ 15,000 m^3/sec

15,000 m3/sec at Kratie ultimately reach the sea following a certain pattern which we must ascertain. Practical methods of discharge measurements in the stations influenced by the tide remain to be studied. We might also mention other problems in Viet-Nam, such as the statistical estimation of discharges in the natural or artificial canals which carry the Mekong discharge; in particular it would be necessary to measure the discharge of the two Vaicos, which discharge we estimated to more than 5,000 m3 in flood period.

In Cambodia, the delta problems are somewhat different but equally complex, and they are made even more so by the problem of the Great Lake. For instance, any development project between the Mekong and Bassac would require a knowledge of the inflow from the right bank of the Mekong and exchanges from the left bank of the Bassac. A project on the left bank of the loop of the Mekong at Phnom Penh would require detailed study of the Tonle Toch, which short circuits the Mekong between Kompong Chhan and Neak Luong. The same is true between the right bank of the Mekong and the Prek Kdam - Kompong Thom road, as well as in the Bassac area.

In Thailand, we may mention the case of the Nam Mun and Nam Chee rivers, which raises a problem of flood prediction necessitating an increase in the number of hydrologic stations. The problem is rendered more complex by the fact that the course of the Nam Chee is not yet stabilized.

Finally, in Laos, without mentioning the hydrologic problems raised by Pa Mong Reservoir and by navigation, it will be necessary to evaluate the considerable hydraulic potential, which will involve a systematic survey of the regime of all types of rivers.